

# PATENT SPECIFICATION

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- (21) Application No. 33482/74 (22) Filed 29 July 1974  
 (31) Convention Application No. 805 683 (32) Filed 4 Oct. 1973 in  
 (33) Belgium (BE)  
 (44) Complete Specification published 19 May 1976  
 (51) INT. CL.<sup>3</sup> B65H 54/76  
 (52) Index at acceptance  
 D1F 5  
 D1D 2G5C 2G5E



## (54) AN ELECTROMECHANICAL SYSTEM FOR CONTROLLING THE SPEED OF A COILER AT THE OUTPUT OF A TEXTILE CARDING MACHINE

(71) We, TEXCONTROL, a Belgian Body Corporate, of Rue des Goujons 154, B-1070 Brussels, Belgium, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an electromechanical system for controlling the speed of a coiler at the output of a textile carding machine by detecting variations in the output speed of the fibre strip which is delivered by the carding machine and is rendered uniform by appropriate drafting means such as are used in textile spinning.

A system according to the invention is of use wherever relatively frequent variations in reeling or coiling speed are needed in dependance upon the output speed of a material to be reeled or stored, a problem found in the textile industry and elsewhere.

In the textile industry, many endeavours have been made to devise means for rendering uniform the cross-section or titre of fibre strips delivered by carding machines.

The provision of uniform fibre strips is important for the following reasons.

Yarn is produced by drafting a sliver which in turn is produced from the drafting of a fibre strip produced by a carding machine. Any irregularities in the fibre strip used to produce a sliver are reproduced in the sliver and are subsequently repeated in the yarn.

Faults in the yarn lead to defects in the finished fabrics which are difficult to remedy. Faults in the yarn also give rise to considerable difficulties during weaving and even spinning, weak spots causing accidental breakages and oversize spots leading in the finished weaves and knits to faults which can only be remedied by repairing, a very expensive manual operation. Long-

term irregularities cause "stripes" in weaves and knits. Unfortunately, such faults in the finished articles cannot be remedied and accordingly reduce the value of such articles.

In order to produce an even yarn, the sliver from which the yarn is produced must be even, as must the fibre strip from which the sliver itself is produced.

Unfortunately, the fibre strip delivered by a carding machine is insufficiently regular to be used without further treatment. In order to produce a regular fibre strip from the output of a carding machine, therefore, spinners have had recourse to a process known as doubling. For instance, a sliver has commonly been produced by two doublings of six or sometimes eight strips, so that a sliver results from combining, for example, thirty-six strips. Statistically, irregularities in the strips cancel one another out in the doubling process.

Various arrangements have been proposed for regulating the titre of fibre strips from carding machines and, on the basis of an article in "International Textile Bulletin" — spinning — 1972 which listed the various fibre strip regulating systems exhibited at the 1971 Paris International Textile Machinery Exhibition, such arrangements may be classified in two main categories.

A first category comprises the so called "control" systems which provide only long term regulation of the strip titre. In such systems, a titre-measuring element is disposed downstream of a or each regulating element which serves to act on the fibre strip to regulate its titre, that is, the titre of the strip is measured after it has been subjected to the action of the regulating elements. If the titre departs or tends to depart from the required rated value, the control system acts on an element of the carding machine to restore the titre to the

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required value. Usually, the speed of the carding machine feed cylinder is adjusted to vary the titre of the strip.

A second category of known regulation comprises the so called "guide" systems which provide both long and short term regulation. By "long-term regulation" is meant the provision of a constant strip titre as measured over lengths greater than about 10 metres while the term "short-term control" is meant the provision of a constant strip titre over lengths less than 1 metre. In the case of guide systems, the titre is measured upstream of regulating elements which operate to provide correction of strip titre in dependence upon the values found at the time of measurement. In this case, regulation is achieved by adjusting not the card machine itself but separate regulating elements arranged to correct the strip titre after carding. In such regulation, titre correction is usually performed by subjecting the fibre strip delivered by the carding machine to a slight and variable drafting, the variations in the drafting applied to the strip compensating for the measured variations in the strip titre.

The main advantage of the control system type of regulation is that measurement of the titre is performed on the strip after it has been regulated, so that the system performs a continuous checking of the quality it has provided. If the degree of regulation is not completely satisfactory then the system adjusts the regulating elements until it is. Another advantage is the constructional simplicity of such arrangements. The control system type of regulation however has faults. In particular, the time delay between the need for titre correction becoming apparent and the correction of the irregularity sets a limit on the effectiveness of a system so far as the interval between irregularities is concerned, since it is impossible to compensate for irregularities occurring below several tens of metres.

The main advantage of the guide system type of regulation is its very rapid compensating action and therefore its provision of very good short term regulation i.e. irregularities of short length can be adequately dealt with.

Unfortunately, guide systems which regulate strip titre by varying the amount of drafting applied to the strip cause the strip to have a variable output speed which is proportional to the amount of drafting. The same principle can be used to vary the input roller speed whilst maintaining the output speed constant, but this merely shifts the problem in that a variable input speed and a constant output speed pose

difficulties which are analogous to the case of a constant input speed and a variable output speed. The guide system type of regulation is accordingly only satisfactory if means are provided for absorbing the variations in strip output speed.

Various means which provide fairly effective absorption of variations in strip output speed have been described. For instance, in the apparatus disclosed in French Patent Specification No. 2 031 012 a strip or sliver accumulator is disposed either between the titre-regulating system and the coiler or between the carding machine and the guide system. In either case, the accumulator is provided with means for detecting the quantity of fibre strip or sliver held in the accumulator. The quantity detector, which may be optical or gravitational for instance, regulates either the average speed of the input rollers of the variable-drafting train used to control the strip titre or on the average speed of the coiler. In either case, the disadvantage of the system is the need to store the strip or sliver in the accumulator, since the strip leaving the card or guide system has very little cohesion and is easily damaged. The passage of the fibre strip through the accumulator, into which it is introduced at the top and removed from the bottom, produces irregularities in the form of knots, partial breakages and various other faults which cancel out the beneficial effect provided by the guide system.

Some other means for compensating variations in the strip output speed are therefore needed if all the advantages of the guide system type arrangement are to be realised, and it is an object of this invention to provide an improved guide system type of regulation with improved means for compensating the strip output speed variations.

Accordingly, the present invention provides an electromechanical system for controlling the speed of a coiler at the output of a textile carding machine provided with a drafting train for drafting the output fibre strip of the carding machine, which system includes a cylindrical tube having a first straight portion aligned with the direction of movement of the fibre strip through the drafting train and into which the strip passes on leaving the drafting train, and a curved portion connecting the said first straight portion to a second straight portion having a flared end through which the strip leaves the tube, the tube being pivotable about the axis of the said first straight portion, and the tube being mechanically connected to an angle sensing device operative to sense movement of the tube about the said axis and to deliver to a computer an electrical signal

which is significant of the said movements and is used to control the speed of rotation of the coiler.

In order that the invention may be clearly understood, an embodiment thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an illustration of part of a known guide system type of regulator employing an accumulator for the fibre strip;

Figure 2 illustrates an electro-mechanical system embodying the present invention;

Figure 3 illustrates part of the Figure 2 system on an enlarged scale;

Figure 4 is an exploded view of a strip position sensor;

Figure 5 illustrates the portion of the position sensor for converting the strip position into an electrical signal; and

Figure 6 shows the drive arrangement for the coiler.

Referring to Figure 1, a known way of compensating for variations in the output speed of a fibre strip from a carding machine (not shown) provided with a variable-drafting train (not shown) for regulating the strip titre involves disposing a fibre strip accumulator either between the drafting train and the coiler or between the carding machine and the drafting train. In Figure 1, the former arrangement is illustrated. In either case, the accumulator has means for detecting the quantity of fibre strip held in the accumulator. The detecting means, which may be optical or gravitational, acts to control the average speed either of the input rollers of the variable-drafting train used to control the strip titre or of the coiler. In either case, the disadvantage is storage of the fibre strip in the accumulator where it may sustain damage.

As previously stated, a guide system type of regulation evens out titre by providing a slight and variable drafting at the exit from the card. The variable drafting is given in dependence upon variations in the strip titre as measured at the output of the carding machine. This system can provide very good short term control.

Referring to Figure 2 which illustrates an embodiment of the invention, the guide system comprises a first pair of rollers 21 which serve both as an element for measuring the instantaneous density of the strip and as input rollers of a variable-drafting train. The rollers 21 are mechanically driven by the carding machine (not shown) and so their speed is completely synchronized with the speed of the carding machine. A second pair of rollers 22 constitute the drafting rollers of the variable-drafting train and are directly driven by a low-inertia motor 23 so as to

be able to follow very closely the speed variations required to regulate the strip titre. The rollers 22 are placed far enough away from the rollers 21 to leave a drafting zone 24 of a length appropriate to the average length of the fibres being processed. Both pairs of rollers 21, 22 have tachometer sensors 25, 26 whose speed signals go to an electronic computer 27. The computer 27 also receives information on the instantaneous density of the fibre strip from a transducer 28 which is associated with the first pair of rollers 21 and which forms the strip density sensing element. The computer calculates the average draft set by the operator and the variations around the average to even out strip titre.

The speed of the drafting motor 23 is controlled by a closed-loop system which checks continuously whether the instantaneous speed of the drafting rollers is the right speed for optimum control and which therefore determines the drafting rollers speed needed to compensate for measured titre variations.

Clearly, the computer makes allowance for the slight delay between the time of measurement and the time when the corrected drafting takes effect so that the correction occurs exactly when the measured part of the strip is passing through the drafting zone. The system, although at first sight very simple, requires very careful development since all components are designed for very low inertia, the only way in which effective very short term control can be provided. It is believed that the system described herein is the only one capable of providing very short term control of titre over less than 10 cm. The strip output speed is therefore basically a varying one, and so another function of the computer is to calculate the required average speed for coiler 29. To obviate any mechanical stressing of the strip and to obviate any form of accumulation with its attendant disadvantages, it must be possible to impart to the coiler secondary speed variations around an average speed which are fast enough to ensure that the strip does not have to travel along a varying path. Such a system is illustrated in more detail in Figures 3 to 6 and will be described hereinafter.

The system embodying the present invention provides continuous and effective supervision without a fibre strip accumulator or mechanical stressing of the fibre strip. The system embodying the invention is incorporated in a system of strip titre regulation wherein the drafting of the fibre strip is varied as hereinbefore described. The variations in drafting are under the supervision of the electronic computer 27 which receives all the data re-

quired for proper control, including the instantaneous titre, strip speed when leaving the carding machine, speed of drafting train and so on.

5 The computer also provides supervision to a first approximation of the average or primary coiling speed of the strip in the coiler. However, due to the considerable inertia of the mechanical parts of the coiler and to the increasing inertias of the cans (depending on the weight of the can in which the strip is coiled, such weight possibly being 30 kg. or more), rapid and effective secondary supervision of the average speed of strip winding is also required, to preclude accumulation of strip and any appreciable variation in strip path, both of which factors may nullify the effects of the control. The system embodying the invention acts on the fibre strip part immediately at the exit from the drafting train and before the coiler (see Figure 2). The system includes (Figure 4) a cylindrical tube through which the fibre strip passes and which comprises two parts 1 and 2. The tube part 1 comprises a first straight portion into which the fibre strip passes on leaving the drafting train and a curved portion joined to the tube part 2 which forms a second straight part having a flared end through which the strip leaves the tube. The tube is pivotable about the longitudinal axis AB of the tube part 1.

Upon leaving the drafting train 21, 22 the fibre strip passes through the tube 1, 2 before being released to go to the coiler. A shaft mounting the tube for pivoting rides on a ball bearing and carries, at the end which is inside a casing 8, a magnetic segment 3 the angular position of which depends on the angular position of the member 1 and of the flared portion 2 (see also Figure 5). Disposed on the same shaft as the segment 3 is an eccentric ring 4 acted upon by a pivotable lever 5 biased into engagement with the ring 4 by a spring 6 whose tension can be adjusted by shifting its place of attachment to an eccentric 7. The ports 4 to 6 are so devised that the tube part 1 and the tube part 2 are substantially in balance.

The flared portion 2 of the tube tends naturally towards a vertical position. In the maximum inclination, the tension which the flared portion 2 applies to the fibre strip is very slight. Further, the moment of inertia of the rockable system, i.e. of the tube parts 1 and 2 and lever 5, is at its minimum so that the oscillations can be a faithful reproduction of the oscillations of the fibre strip which it is required to supervise.

Upon leaving the flared portion 2 the strip goes to the coiler 29 so as to make the flared portion 2 take up an average

angular position. Variations of such position around the average act via an appropriate electronic system to control the secondary variations of coiler speed.

Permanent magnets 10 mounted in the casing 8 act on reed switches 11 disposed on a cover 9 opposite the magnets 10, the magnetic sector being disposed in the casing 8 between the magnets 10 and the switches 11. The passage of the sector 3 between the magnets 10 and the reed relays 11 controls the operation of reed switches 11 without reaction on the sector 3 and therefore without reaction on the flared tube part 2. The angular position of the flared part 2, if it causes a variation of the angular position of the sector 3, acts via the reed switches 11 to vary the coiler speed.

To overcome inertia caused by the mechanical parts of the coiler and by the weight of the material in the cans, such weight varying during the process, it was decided to use an a.c. motor 12 of adequate power and running at a constant maximum speed (see Figure 6). The motor 12 drives the coiler (which has an electronic tachometer) via an electromagnetic clutch 13. The coiler is also associated with an electromagnetic brake facility 14.

The titre control computer acts alternately at high frequency on the clutch 13 and brake 14 to make the coiler run at an average speed which suits the average drafting rate determined by the computer and which is controlled by the electronic tachometer.

The time slots for operation of the clutch and/or brake are devised to provide the required average speed and also, in response to the angular position of the flared portion 2, to provide speed variations around the average such that no undesirable stress is applied to the fibre strip.

#### WHAT WE CLAIM IS:—

1. An electromechanical system for controlling the speed of a coiler at the output of a textile carding machine provided with a drafting train for drafting the output fibre strip of the carding machine, which system includes a cylindrical tube having a first straight portion aligned with the direction of movement of the fibre strip through the drafting train and into which the strip passes on leaving the drafting train, and a curved portion connecting the said first straight portion to a second straight portion having a flared end through which the strip leaves the tube, the tube being pivotable about the axis of the said first straight portion, and the tube being mechanically connected to an angle sensing device operative to sense movement of the tube about the said axis and to de-

liver to a computer an electrical signal which is significant of the said movements and is used to control the speed of rotation of the coiler.

5 2. A system according to claim 1, in which the second straight part of the tube is inclined to the axis of pivoting.

3. A system according to claims 1 and 2, in which the tube is rigidly secured to a  
10 pivot spindle connected to a magnetic sector moving past a reed relay, the magnetic sector and tube forming a low-inertia system biased by an adjustable spring which provides a virtual balancing of the  
15 system and prevents any substantial stressing of the fibre strip.

4. An electromechanical system for

controlling the speed of a coiler at the output of a carding machine substantially as hereinbefore described with reference to, 20 and as illustrated in, Figures 2 to 6 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1976.  
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies  
may be obtained.

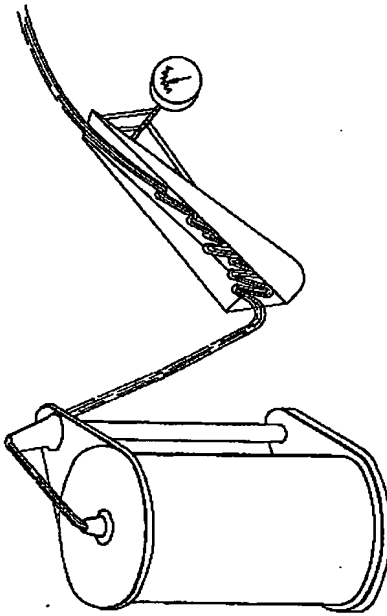
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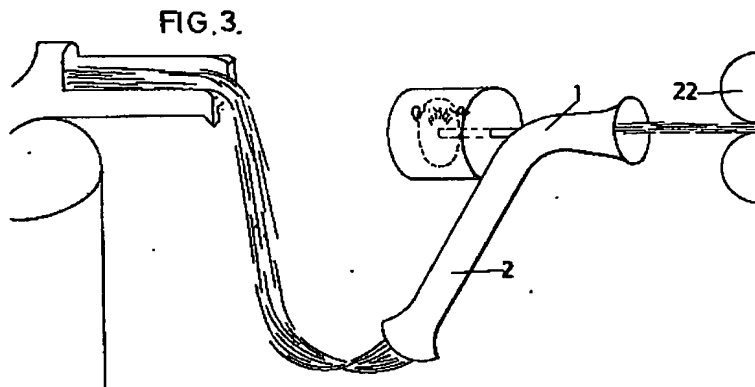
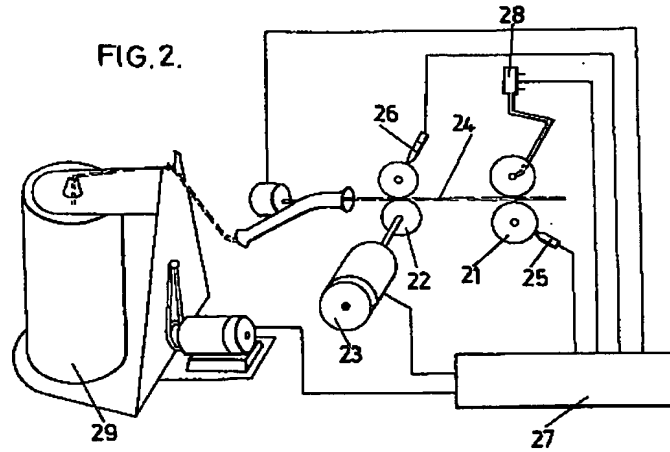
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FIG.1.





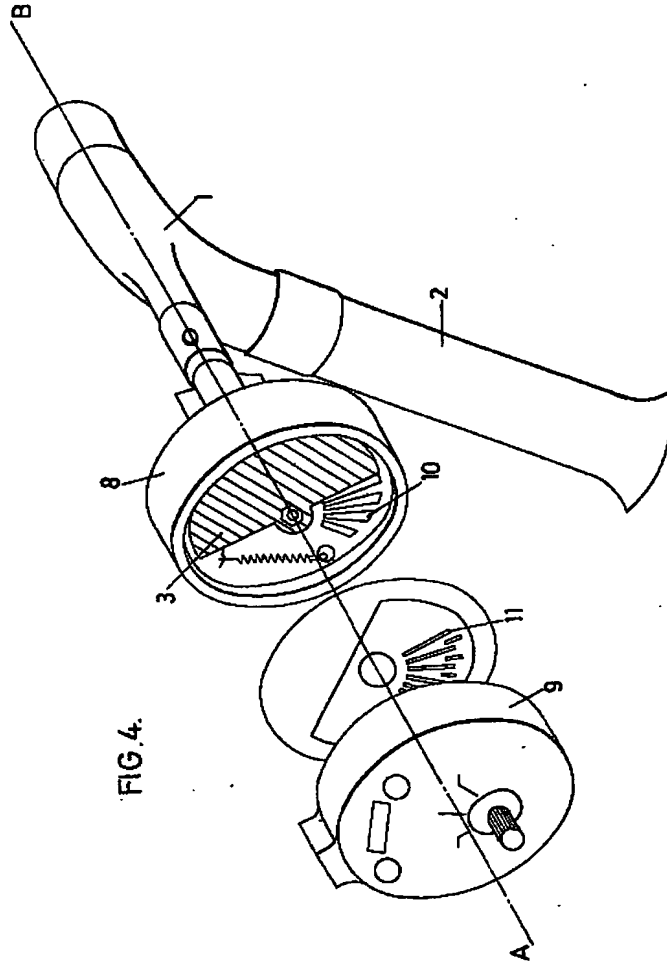
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FIG. 5.

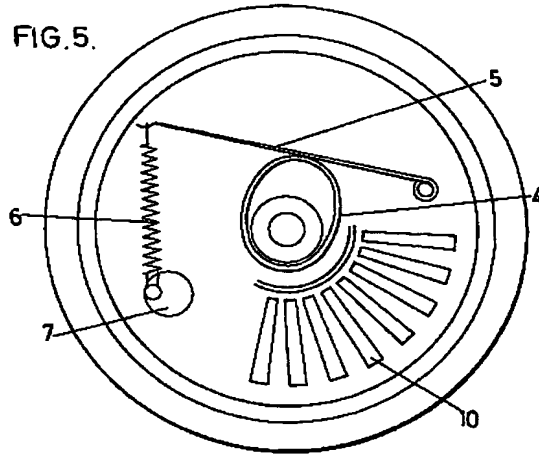
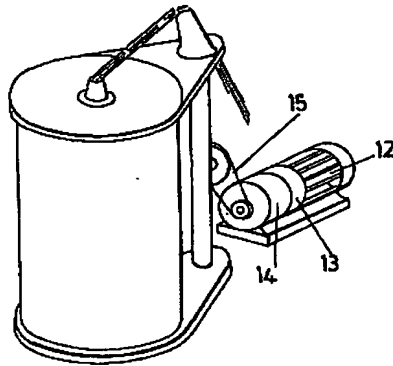


FIG. 6.



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